Fleet Models for the Marine Life Protection Act

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Why do we need a fleet model?

- Biomass dynamic models seek to predict ecological effects of regional marine protected area (MPA) proposals
 - Space is broken into 1 km² discrete "patches"
- Ecological effects depend on spatial fishing effort outside MPAs
 - How is effort currently distributed?
 - Where will effort go after MPAs implemented?

How do fleets behave?

- "Effort" = time fishing to achieve given fishing mortality
- Spatial fishing effort responds to:
 - Fish densities (adult biomass)
 - Distance from port
 - Fishing conditions/weather
 - Others' fishing effort in the patch
- Effect of each variable may differ across:
 - Fleets (commercial, recreational)
 - Species

"Value" of fishing a patch

$$\pi_{i} = \alpha_{1} f(E_{i}, B_{i0}) - [\alpha_{2} D_{i} + \alpha_{3} W_{i} + \alpha_{4}] E_{i}$$

- Where
 - /indexes a patch
 - B is current adult biomass
 - E is effort
 - f(B,E) is harvest
 - D is distance
 - W is weather
 - $\square \alpha_1 \dots \alpha_4$ are parameters

How is effort distributed?

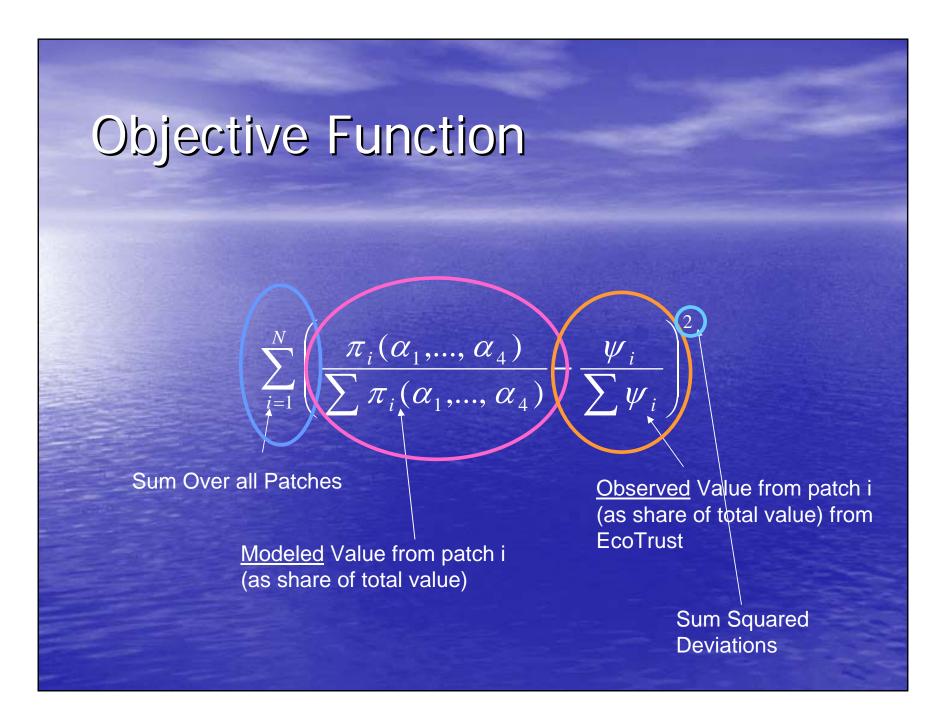
- We assume fishermen choose to fish the patches that will return <u>highest value</u>
- Marginal value is:

$$\frac{\partial \pi_i}{\partial E_i} = \alpha_1 f'(E_i, B_{i0}) - \alpha_2 D_i - \alpha_3 W_i - \alpha_4$$

All fished patches have equimarginal value

Fitting model parameters

- How do we know the value of the parameters $\alpha_1, \ldots \alpha_4$?
 - 1. Assume values for $\alpha_1, \ldots \alpha_4$
 - 2. Find patch-specific effort that satisfies equimarginal value
 - 3. Find associate value for each patch
 - 4. Compare prediction with data
 - 5. Repeat to choose $\alpha_1, \ldots \alpha_4$ to optimize fit to data.



Summary

- To predict ecological effects of MPAs, we need a fleet model
- We'd like fleet model to: (1) accord with basic principles, (2) match effort distribution data under current conditions, (3) provide means of predicting fleet movement under any regional MPA proposal
- Our procedure generates a fleet model that is consistent with principles, existing data
 - But can also be used to forecast fleet changes under MPAs